# Method and device for recording information on a record medium, record medium containing information, and method and device for reading information from a record medium

## FIELD OF THE INVENTION

The present invention relates in general to the field of recording information on a record medium and, conversely, reading the recorded information from the record medium.

More particularly, the present invention relates to the field of optical recording, in which case the record medium typically is an optical disc, but the gist of the present invention is not restricted to optically recording information on a disc.

Further, the present invention relates particularly to the field of recording an audio stream and/or a video stream, but the gist of the present invention is not restricted to such use. As will become clearer in the following, the present invention is applicable in more cases where an information stream has a basic part and one or more optional parts.

Optical discs and disc drives have been developed according to different standards or formats, such as for instance CD standard, DVD standard, etc. A relatively new standard is BD (Blu-Ray Disc). Specifically, the present invention relates to the field of recording and reading BD-ROM, and the invention will be explained hereinafter specifically for this exemplary application, but it is to be noted that it is not intended to restrict the scope of the invention to BD-ROM.

## BACKGROUND OF THE INVENTION

As is commonly known, an optical storage disc comprises at least one track, either in the form of a continuous spiral or in the form of multiple concentric circles, of storage space where information may be stored in the form of a data pattern. Optical discs may be read-only type, where information is recorded during manufacturing, which information can only be read by a user. The optical storage disc may also be a writeable type, where information may be stored by a user. Since the technology of optical discs in general, the way in which information can be stored in an optical disc, and the way in which optical data can be read from an optical disc, is commonly known, it is not necessary here to describe this technology in more detail.

Optical discs have found widespread use as information carrier, not only for storing computer data, but also for making audio and/or video recordings. Apparatus are available for allowing a user to make his own recordings on writeable discs. Also, audio publishing companies or video publishing companies publish pre-recorded discs, which are read-only discs (ROM); play-back apparatus are available for allowing a user to play such discs. In such play-back apparatus, indicated hereinafter simply as player, a disc drive component reads and decodes the data recorded on disc, and a video stream and/or audio stream is generated, suitable for display via a display device such as a television apparatus, a monitor, a loudspeaker, etc. This is explained in the following example.

A movie may contain several elements, indicated as follows:

**Moving pictures**, i.e. the actual pictures of the movie, to be displayed on the TV screen. The contents of the moving pictures are stored in a video elementary stream. It is possible that a disc contains multiple alternative video elementary streams, for instance to allow a user to view scenes from different angles, but this is not relevant for the present invention and will be ignored in the following discussion: it is assumed that there is only one video elementary stream.

**Graphics pictures**. Graphics pictures are overlayed on the moving pictures like a picture-in-picture presentation. Graphics picture are used for transmitting subtitles. They may consist of background graphics (e.g. a still picture) and some text. The contents of the graphics pictures are stored in a graphics elementary stream, separate from the video elementary stream, so a user has the option of viewing the movie with or without graphics. Usually, a user is given the option to choose a language, in which case different graphics pictures are provided, associated with different languages. In such case, the movie is accompanied with a set of multiple graphics elementary streams, one for each language.

**Audio signals**. The audio signal of a movie consists of background audio and spoken text, and this combination is stored in an audio elementary stream, separate from the video elementary stream. Usually, a user is given the option to choose a language, in which case the spoken text is different for different languages while the background audio is the same for all languages. In such case, the movie is accompanied with a set of multiple audio elementary streams, one for each language.

A combination of multiple elementary streams (for instance: moving pictures + graphics + audio) can be transmitted in one Transport stream. Each transport stream is stored as a separate file.

Traditionally, an information carrier contains only one version of the movie. With the ongoing development of optical discs, especially the increase in data storage capacity, it has become possible for the information carrier to contain two or more versions of the movie, allowing a user to select which version he wishes to see. For instance, one user may wish to see the movie in its original version, but another user may wish to have subtitles. Yet another user may prefer to hear the spoken text in his own language.

According to the state of the art, especially the well-known DVD-VIDEO standard, several different versions of the audio elementary stream and the graphics elementary stream are recorded in one transport stream, packets of the elementary streams being multiplexed in the transport stream. Depending on a user's choice, only one of the several different versions of the audio elementary stream is selected during playback, and only one of the several different versions of the graphics elementary stream is selected during playback.

A disadvantage of this approach is that it consumes relatively much storage space. For instance, consider a case where an original English-language movie is to be published with optional French-spoken text and optional German spoken text. In that case, a first audio elementary stream would contain the combination of background sound and original English-spoken text, a second audio elementary stream would contain the combination of background sound and French-spoken text (translation 1), and a third audio elementary stream would contain the combination of background sound and English-spoken text (translation 2). Thus, the information relating to the background sound, common to all three audio transport streams, is recorded three times.

Likewise, consider a case where a movie is to be published with English, French and German subtitles on a common background graphics still picture. In that case, a first graphics elementary stream would contain the background still picture plus the English text, a second graphics elementary stream would contain the background still picture plus the French text, and a third graphics elementary stream would contain the background still picture plus the German text. Thus, the information relating to the background still picture, common to all three graphics elementary streams, is recorded three times.

Another disadvantage of the current approach is that all elementary streams are collected in one transport stream. During playback all information has to be read, including the non-used elementary streams. This increases the bit rate during playback. It is an important objective of the present invention to overcome said disadvantage.

SUMMARY OF THE INVENTION

According to an important aspect of the present invention, the video, graphics and audio information is stored as multiple transport streams, i.e. without completely mixing the elementary streams. As mentioned before, there is one video elementary stream in this example. The graphics information is stored as one basic graphics elementary stream (also indicated hereinafter as background graphics elementary stream) and one or more optional graphics elementary streams. Likewise, the audio information is stored as one basic audio elementary stream and one or more optional audio elementary streams. There is one basic transport stream that contains the video elementary stream, the background graphics elementary stream, and the background audio elementary stream.

In a playback situation, a user selects one of the optional elementary graphics streams and/or one of the optional audio elementary streams. The disc drive reads the basic transport stream and the selected one (or more) of the optional elementary streams, which are provided to the player. The player mixes the input video and graphics signals as received from the drive, i.e. the video elementary stream from the basic transport stream, the background graphics elementary stream from the basic transport stream, and the optional elementary graphics stream, to generate a picture for the graphics plane. Likewise, the player mixes the audio signals as received from the drive, i.e. the background audio elementary stream from the basic transport stream, and the optional audio elementary stream, to generate a mixed audio signal.

With this approach, an important saving of storage space can be achieved. First, the basic elementary streams are recorded only once. Second, it is possible that subtitles are recorded in a character coding, which is a very efficient way of coding which requires very little storage space.

Also the total bit rate during playback is reduced, since the non-used elementary streams are not read.

As a consequence, it becomes possible to record longer playtime (longer movies or more movies) on the same disc. Further, it becomes possible to provide more movie versions on the same disc (more languages of subtitles and spoken text). Since the individual files containing one language subtitle or one language spoken text are relatively small files, it becomes feasible that additional files are provided later, for instance to be downloaded through Internet, which files may be stored for instance on the hard disc of the user's computer. It is also possible that the published optical discs have a writeable area, where such additional optional elementary streams can be recorded.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects, features and advantages of the present invention will be further explained by the following description with reference to the drawings, in which same reference numerals indicate same or similar parts, and in which:

Figure 1 schematically illustrates the creation of audio streams and graphics streams according to the state of the art;

Figure 2 schematically illustrates the creation of audio streams and graphics streams according to a first embodiment of the present invention;

Figure 3 is a block diagram schematically illustrating an embodiment of an audio/video reproduction system;

Figure 4 is a flow diagram schematically illustrating the operation of a disc player according to the present invention;

Figure 5 schematically illustrates the creation of audio streams and graphics streams according to a second embodiment of the present invention;

Figure 6 schematically illustrates the creation of audio streams and graphics streams according to a third embodiment of the present invention.

DESCRIPTION OF THE INVENTION

Figure 1 schematically illustrates the creation of audio files and graphic files according to the state of the art, for the case of a movie M comprised of moving pictures 1, background sound 2, and spoken text in an original language 20. It is desired to offer a user the following choices:

A) regarding spoken text:

- original language
- spoken text in a first translation
- spoken text in a second translation

B) regarding subtitles:

- no subtitles
- subtitles in original language
- subtitles in a first translation
- subtitles in a second translation

To allow this functionality in prior art, one video elementary stream 61 is generated, three audio elementary streams 41, 42, 43 are generated, and three graphics

elementary streams 51, 52, 53 are generated, which are combined into one transport stream 71, which is recorded on disc.

A first audio elementary stream 41 contains a mix of background sound 2 and the original language spoken text 20.

A second audio elementary stream 42 contains a mix of background sound 2 and spoken text 21 in the first translation.

A third audio elementary stream 43 contains a mix of background sound 2 and spoken text 22 in the second translation.

A first graphics elementary stream 51 contains a mix of background graphics 3 and subtitles 30 in the original language.

A second graphics elementary stream 52 contains a mix of background graphics 3 and subtitles 31 in the first translation.

A third graphics elementary stream 53 contains a mix of background graphics 3 and subtitles 32 in the second translation.

In a playback situation in prior art, a drive would read the transport stream 71, as indicated by arrow R, and would provide this transport stream 71 to a player. A user would input his choice to the driver, which would derive from the transport stream 71 the elementary streams corresponding to the user's choice. For instance, assume that a user wishes to watch this movie with spoken text and subtitles in the first translation; in that case, a player will derive or reconstruct files 61, 42 and 52, as indicated by arrows D.

It should be clear that, in the state of the art, the background sound 2, i.e. the sound which is to be reproduced always, independent of the user's choice, is recorded in common in all three audio files 41-43. Likewise, it should be clear that, in the state of the art, the background graphics 3, i.e. the background part of the subtitles which is to be reproduced always in case of subtitles, independent of the user's choice, is recorded in common in all three graphic files 51-53.

Figure 2 schematically illustrates the creation of audio files and graphics files according to a first embodiment the present invention, for the same case. In this embodiment, one video elementary stream 161 is generated, four elementary audio streams 140, 141, 142, 143 are generated, and four elementary graphics streams 150, 151, 152, 153 are generated.

A first elementary audio stream 140 contains background sound 2 only.

A second elementary audio stream 141 contains the original spoken text 20 only.

A third elementary audio stream 142 contains the spoken text 21 in the first translation only.

A fourth elementary audio stream 143 contains only the spoken text 22 in the second translation.

A first elementary graphics stream 150 contains the background graphics 3 only. This may, for instance, involve a frame which, on display, will surround the text of the subtitles. This may also involve a still picture as background for the text, which still picture, in its simplest form, is a rectangle of uniform colour. It is also possible that the subtitles text is projected over the movies pictures without special background, in which case said first elementary graphics stream 150 may be omitted.

A second elementary graphics stream 151 only contains the subtitles 30 in the original language.

A third elementary graphics stream 152 only contains the subtitles 31 in the first translation.

A fourth elementary graphics stream 153 only contains the subtitles 32 in the second translation.

Figure 3 is a block diagram schematically illustrating an embodiment of an audio/video reproduction system 1000. The audio/video reproduction system 1000 comprises a disc player 1100 and a display device 1300, which comprises at least one screen 1301 for displaying images and at least one loudspeaker 1302 for generating sound. The disc player 1100 comprises a disc drive 1200, capable of reading information from a disc 1001, which disc contains information recorded in accordance with the invention. The disc 1001 preferably is an optical disc, and the disc drive 1200 therefore typically is an optical disc drive.

The disc drive 1200 comprises a disc motor 1204 for rotating the disc 1001, and an optical head 1205 for scanning tracks (not shown for sake of simplicity) of the disc 1001. An actuator device 1206 sets the correct positioning of the optical head 1205. A controller 1210 controls the disc motor 1204 and the actuator device 1206. The controller 1210 receives an optical read signal from the optical head 1205.

The disc player 1100 further comprises a user control panel 1101, which comprises user-controllable input means, such as keys, switches, knobs, and the like, allowing a user to enter his selection; since such input means are known per se, they are not shown separately in figure 3.

In a playback situation, a user enters his choice via user control panel 1101, and the corresponding audio streams 140-143 and the corresponding graphics streams 150-153 as well as the video elementary stream 161 are read and mixed. For instance, assume again that the user wishes to watch a movie from disc 1001 with spoken text and subtitles in the first translation; in that case, the disc drive 1200 will read elementary streams 140, 142, 150, 152, and 161, as indicated by arrows R in figure 2, and will output the corresponding background elementary audio stream SA0, first translation elementary audio stream SA2, background elementary graphics stream SG0, first translation elementary graphics stream SG2, and video elementary stream SV0 to the player 1100. The player 1100 comprises audio mixing means 1110 for mixing the two elementary audio streams SA0 and SA2 to create an audio signal SA for the display device 1300. Likewise, the player 1100 comprises graphics mixing means 1120 for mixing the two elementary graphics streams SG0 and SG2 to create a graphics signal SG. The player 1100 further comprises combiner means 1130, which overlays this graphics signal SG over the video elementary stream SV0 to generate a video signal SV for the display device 1300.

It is noted that the combiner means 1130 and the audio and video mixing means 1110 and 1120 may be implemented as one integrated component.

Figure 4 is a flow diagram schematically illustrating the operation of the disc player 1100 in this case. In this embodiment, the disc player 1100 instructs the disc drive 1200 always to read the background elementary audio stream 140 [step 1161] and the elementary video stream 161 [step 1162], independent from the user's choice.

In step 1162, the disc player 1100 checks whether the user has selected display with subtitles. If not, the disc player proceeds at step 1165. If it appears that the user has selected display with subtitles, the disc player 1100 instructs the disc drive 1200 to also read the corresponding background elementary graphics stream 150 and the chosen subtitle elementary graphics stream (in the above example: stream 152) [step 1164], and proceeds at step 1165.

In step 1165, the disc player 1100 checks whether the user has selected display with a translation of the spoken text. If not, the disc player 1100 instructs the disc drive 1200 to also read the original language elementary audio stream 141 [step 1166], and continues at step 1168. If it appears that the user has selected display with translation of spoken text, the disc player 1100 instructs the disc drive 1200 to also read the corresponding translation elementary audio stream (in the above example: stream 142) [step 1167], and proceeds at step 1168.

In step 1168, the disc player 1100 combines the elementary video stream 161, background elementary audio stream 140 and the selected language elementary audio stream 142, the optional background elementary graphics stream 150 and the selected language elementary graphics stream 152 as received from the disc drive 1200, to generate the output transport stream TSO for the display device 1300.

It should be clear to a person skilled in the art that the above steps are continued for the duration of the movie.

In the above example, separate audio and video signals are generated; alternatively, it is possible that a mixed audio/video signal is generated.

An important advantage of the present invention is that, since the texts of the subtitles are stored individually, they may be character-coded, which is very economical. Further, since only the selected elementary streams are read by the disc drive and communicated to the player, the bit rate is reduced.

In the above example, all elementary streams are stored individually. It is also possible that some of the elementary streams are mixed before storing. Figure 5 schematically illustrates the creation of audio streams according to a second embodiment the present invention, for the same case. The main difference between the second embodiment and the embodiment illustrated in figure 2 is to be seen in the fact that, in the present embodiment, the background sound 2 and the original language spoken text 20 are mixed to yield one mixed audio transport stream 241. First, second and third elementary audio streams 240, 242 and 243, containing the background sound 2 and the spoken text 21, 22 in the first and second translation, respectively, correspond to first, third and fourth elementary audio streams 140, 142 and 143, respectively, of the embodiment illustrated in figure 2.

In a playback situation, a user enters his choice, and the corresponding audio streams 241-243 are read and possibly mixed to generate an audio signal. For instance, assume that the user wishes to watch this movie in its original form, i.e. with the original spoken text; in that case, the disc drive 1200 will read the mixed audio transport stream 241, no further mixing being necessary. This may be very efficient, if it is to be expected that this is the most probable user's choice. In another example, assume again that the user wishes to watch this movie with spoken text in the first translation; in that case, the disc drive 1200 will read the background audio transport stream 240 as well as the first elementary audio stream 242, as indicated by arrows R in figure 5 (it is noted that the read-out of pictures and graphics is not illustrated in figure 5), and will output both audio streams to the player 1100. The audio signal SA is then generated by mixing this background elementary audio stream with

the first translation elementary audio stream, as already described with reference to figure 3. In contrast to the prior art where the background sound is always mixed with each language sound, the background sound is only mixed with language sound for the most frequently occurring situation.

It is noted that a similar mixing may be implemented in the visual domain, if it is to be expected that users will most often select subtitles rather than display without subtitles. For instance, in a case where a recording is intended for a country (for instance: the Netherlands) where the national language (Dutch) differs from the original language of the movie (for instance: English) it may be expected that users will tend to select Dutch subtitles. In that case, it may be efficient to mix background graphics 3 with translation subtitles 31 to generate a mixed graphics transport stream instead of a separate elementary stream for translation subtitles 31.

Within the scope of the present invention, such mixing may also be implemented to a higher degree. Particularly, such mixing may be implemented with respect to audio and video in combination, as will be explained with reference to figure 6.

Figure 6 schematically illustrates the creation of audio and video streams according to a third embodiment the present invention, for the same case. In this present embodiment, one mixed audio/video/graphics transport stream 300 is created, which contains the moving pictures 1, the background sound 2, the original language spoken text 20 mixed with the background sound 2, and the background graphics 3. First and second elementary audio streams 342 and 343, containing the spoken text 21, 22 in the first and second translation, respectively, correspond to second and third elementary audio streams 242 and 243, respectively, of the embodiment illustrated in figure 5. Second, third and fourth elementary graphics streams 351, 352, 353, 354, respectively, containing the subtitles in original text and first and second translation, respectively, correspond to elementary graphics streams 151-153, respectively, of the embodiment illustrated in figure 2.

In the situation expected to occur the most, i.e. the user wishing to watch the movie in its original version without subtitles, the disc drive 1200 can simply read the mixed transport stream 300, ignore the background audio and the background graphics and output a Main Transport Stream as is customary in prior art. In a situation where a user has entered a choice deviating from the most frequently occurring situation, for instance the situation that the user wishes to watch this movie with spoken text in the first translation, the disc drive 1200 will read the mixed transport stream 300 as well as the first translation elementary audio stream 342, as indicated by arrows R in figure 6. The disc drive 1200 will ignore the

original language spoken text mixed with the background audio, and will output a Main Transport Stream and first translation elementary audio stream to the player 1100. The audio signal SA is then generated by mixing the background elementary audio stream SA1 with the first translation elementary audio stream SA3, as already described with reference to figure 3.

In a variation of this embodiment, only the background sound 2 and the original moving pictures 1 are mixed, whereas the original language spoken text 20 is recorded as an elementary audio stream.

It should be clear to a person skilled in the art that the present invention is not limited to the exemplary embodiments discussed above, but that several variations and modifications are possible within the protective scope of the invention as defined in the appending claims.

For instance, in the above, several user options relating to audio are only explained for the case of different languages of spoken text. However, it is also possible that that music is recorded in several versions, for instance normal quality audio, high quality audio, MP3, etc. Further, it is possible that separate audio recordings are made for use with exceptional playback situations, for instance slow-motion, still pictures, menu operations, etc.

Further, in the above, several user options relating to video are only explained for the case of different languages of subtitles. However, more variations are possible. For instance, it is possible that subtitles in one language are available in different fonts (Latin fonts, Asian fonts, etc). Further, it is possible that subtitles in one language are available for different projection regions (bottom part of screen, upper part of screen, etc). Further, it is possible that specific subtitles for karaoke are available (possibly in several languages). Further, it is possible that specific graphical background layouts are available for different aspect ratios of the display device. Further, it is possible that specific graphical background layouts are available for projecting the subtitles (transparent, black rectangle for white letters, white rectangle for black letters, coloured rectangle with logo and/or icons, etc).

In the above, the present invention has been explained with reference to block diagrams, which illustrate functional blocks of the device according to the present invention. It is to be understood that one or more of these functional blocks may be implemented in hardware, where the function of such functional block is performed by individual hardware components, but it is also possible that one or more of these functional blocks are implemented in software, so that the function of such functional block is performed by one or more program lines of a computer program or a programmable device such as a microprocessor, microcontroller, etc.